



**Responses to EPA and RIDEM Comments on the
Phase II Investigation Report, IR Program Site 16
Naval Construction Battalion Center Davisville
North Kingstown, Rhode Island**

**Contract No. N62472-92-D-1296
Task Order No. 0097**

Prepared for

Department of the Navy
Engineering Field Activity Northeast
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Prepared by

EA Engineering, Science, and Technology
Southborough Technology Park
333 Turnpike Road (Route 9)
Southborough, Massachusetts 01772
(508) 485-2982

December 2003
EA Project No. 29600.97.3592

**RESPONSES TO EPA COMMENTS DATED 6 AUGUST 2003 ON THE
SITE 16 GROUND-WATER INVESTIGATIVE REPORT OF JUNE 2003
NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND**

GENERAL COMMENTS

Comment 1: The title of this report should be a groundwater investigative report rather than a remedial investigation (RI). A remedial investigation includes both a human health and an ecological risk assessments. The Navy must provide a schedule for completing both the soils and sediment investigation to support the risk assessments and for the reporting of the assessments. The Navy agreed to provide such a schedule on August 8, 2003.

Response— The title of this report will be changed to "Phase II Hydrogeologic Investigation, IR Program Site 16."

Schedules for completing both the soils and sediment investigation to support the risk assessments and for the reporting of the assessments were provided in the Navy's letter dated 19 August 2003.

Comment 2: The human health risk assessment must include an assessment of the possibility of vapor intrusion from the soil and groundwater contaminants.

Response— The Navy will consider an evaluation of the possibility of potential future exposure pathways for vapor intrusion at Site 16. However, the Navy would like to discuss with the EPA how an evaluation of vapor intrusion should occur, taking into consideration potential future reuse of area, site geology, and the uncertainty in using carcinogenic slope factors for some VOCs present in Site 16 ground water to evaluate potential vapor intrusion risks.

Comment 3: Screening level FID and PID hits noted in boring logs must be discussed in the text. There were numerous hits that the Navy should take into account in determining the nature and extent of groundwater contamination and in making future recommendations for work at this site. No discussion of these hits was found in this report nor were any recommendations made to further investigate the hits. The Navy must investigate the possible additional sources as part of a thorough RI at this NPL Site.

Response— FID/PID soil screening data was used to aid in selection of the screened intervals of the monitoring wells. Soil sampling will be conducted to further investigate "hits" (particularly where little to no VOC or SVOC were detected in ground-water samples collected from similar depth intervals) during the Supplemental Phase II Investigation of the site.

Comment 4: The conclusions and interpretations arrived at by EPA are somewhat different from the limited ones of the Navy. Review of the data contained in the Groundwater Investigation report, along with data from the Phase I Remedial Investigation report, and the monitoring event reports for Site 03, support the interpretation that there are three documented areas of chlorinated volatile organic compound (CVOC) release impacting Site 16. As pointed out by EPA previously, the central "onsite" area of Site 16 and the railroad spurs area near former Building 41 appear to be sources of contamination of varying and still unknown magnitude. Release from the central "onsite" area appears to have the most impact of the two. The Navy appears to acknowledge this as a result of the additional investigations conducted during this Phase II work. The magnitudes of the "onsite" releases do not appear to be fully recognized by the Navy, however. Also, the Navy does not interpret an impact to Site 16 to have occurred from a release at the former Nike PR-58 site and/or Site 03. EPA has a differing opinion in that the data strongly suggests that there is an impact, although possibly a minor one.

EPA has a somewhat differing interpretation of the impacts of the documented releases within the central "onsite" area of Site 16 and the railroad spur area. EPA interprets Site 16 groundwater to be impacted in a very complex manner through a convergence of the three source areas including multiple release areas in the "on-site" area. There appear to be at least two documented significant release areas within the central area that migrate in either two directions or in an adjacent radial manner. One of these release areas may be a contributor to observed high levels of contaminants beneath the former Building 41 footprint. The other appears to add to observed contamination along the upper portion of the northeast trending "trough." The release at the railroad spur, while significant, may not be a major factor in the observed contamination below the footprint of the former Building 41 or the "trough" trending northeast. However, that area of contamination released appears to migrate predominantly to the east and the southeast portion of Site 16. There is also an apparent third area in the southeastern quadrant of the "onsite" area that is still unresolved. This area is represented by the groundwater results from MIP16-24 during the Phase I Remedial Investigation and further suggested by the results of the data collected from this current investigation.

Response— Comment noted. However, the Navy does not agree with the statement that "the data strongly suggests that there is an impact" to Site 16 from a release at the former Nike PR-58 site and/or Site 03. The Navy believes that a reasonable source for the CVOC detected in deep ground water beneath the northeastern end of the former Building 41 was from spills related to the historical activities (early 1950s) in that building and that the actual locations of such potential 50+ yr old spills may never be identified.

Comment 5: It is also not clear what the purpose of the Natural Attenuation presentation and discussion is. First, prior to assessing natural attenuation a full, comprehensive understanding of the site conceptual model must be at hand. This does not appear to

be the case. This is necessary to determine actual background terminal electron acceptor concentration, starting concentrations of CVOC contaminants, and compare relative changes in concentrations of CVOC constituents along the axis of plume(s) migration. Second, distribution of natural attenuation parameters (shown of table and figures) presented in the Groundwater Investigation Report is limited by the distribution of the available monitoring wells and likely non-uniform and random distribution of certain terminal electron acceptors including nitrates, sulfates, etc.

Response— The Navy added the scoring of this site using the AFCEE approach to preliminarily assess the potential for the site subsurface to naturally support biodegradation of VOC. The Navy agrees that any investigation that includes ground-water sampling “is limited by the distribution of the available monitoring wells” and/or other types of sampling locations or methods (e.g., direct push).

Comment 6: Site 03/PR-58 Source Contribution

There are a number of factors that strongly indicate that the Site 03/PR-58 release(s) contribute to observed contamination in the Site 16 area. These include the following:

- A. Presence of CVOC compounds found in the Sites 03/PR-58 groundwater.
- B. Sites 03/PR-58 are hydraulically up gradient from Site 16 for all groundwater zones.
- C. Recharge areas up gradient (Sites 03/PR-58) and discharge areas within Site 16.
- D. Groundwater travel velocity is adequate to allow transport during elapsed time.
- E. Strongly elevated pH in groundwater, from Sites 03/PR-58 to Site 16.
- F. Bedrock trough that suggests a preferential migration pathway from Sites 03/16.
- G. Tetrachloroethane (PCA) conversion to Trichloroethylene (TCE) at Sites 03/PR-58 areas.

Each of these indicators when evaluated together strongly suggests a release from the Sites 03/PR-58 areas that cannot be summarily dismissed with the existing data (MW16-55D/R/R2 notwithstanding). On the contrary, the result points to a significant data gap in between the former Building 41 footprint area and Sites 03/PR-58.

Comment 6A. CVOC compounds

As was pointed out in the assessment of the Phase I Remedial Investigation the presence of low concentrations of several ethane compounds was detected in Site 16 groundwater. These constituents include Dichloroethane (1,1 DCA), Trichloroethane (1,1,2 TCA) and Chloromethane. Also detected was Tetrachloroethylene (PCE). Review of the data from the Site 03 Monitoring Event reports and existing data for the former Nike PR-58 site show that these compounds are prevalent in the Sites 03/PR-58 areas. The ethane compounds are present at relatively low concentrations and are associated with the presence of PCA, either as impurities or degradation products. Within the Site 16 area these constituents are not uniformly distributed. Although they have been detected within the central "onsite" area they appear predominantly in the south and west portion of the site closest to the Sites 03/PR-58 areas. This area is predominantly up gradient from the major source areas within Site 16 proper, including the central "onsite" portion of Site 16 and the Railroad Spur area. For instance, MW16-10D, MW16-12D, MW16-33D, MW16-54D all lie totally up gradient from the closest documented release area (MW16-37). This distribution suggests that the origin of these CVOC constituents lies further to the west.

Response— Comment noted. Please see the Navy's responses to EPA General Comment Nos. 4 and 6C.

Comment 6B. Groundwater Flow Pathways

Review of the groundwater flow pathways as depicted on Figures 3-21 through 3-28 of the Groundwater Investigation Report clearly shows that groundwater that flows through the Site 16 area has its origins within the Sites 03/PR-58 areas. For several of these figures, there is an area between Building 41 and the Sites 03/PR-58 zone that has a limited number of groundwater monitoring wells. This data gap limits the resolution of more detailed groundwater flow path within that area. However, the overall flow direction from Sites 03/PR-58 is nonetheless clearly indicated by the data points and groundwater contours drawn. This is especially clear for groundwater flowing in the intermediate, deep, and rock groundwater zones. Given that there is documented groundwater contamination in the Site 03/PR-58 area, it is totally reasonable to expect that contamination from that area would migrate through the Site 16 area.

An issue affecting refinement of groundwater flow pathways is the lack of information relative to groundwater hydraulics in the Sites 03/PR-58 areas. Within the area of which there are wells (Site 03) there is a large zone between MW03-08D/R and EA110D/R that is not monitored. Additionally, where there are wells many exist as sole wells, either deep (MW03-10D), or rock (MW03-11R). There is a scarcity of well pairs to refine groundwater vertical flow. Also, there is a lack of effective groundwater monitoring to the south of Sites 03/PR-58. Review of Figures 3-21

through 3-28 shows that groundwater from Sites 03/PR-58 flows through this area on its way toward Site 16. These deficiencies have been noted by EPA at various times during comments on the long-term monitoring for Site 03 and the Phase I Remedial Investigation Report.

Response— Comment noted. The Navy agrees that portions of the former PR-58 Nike site and the Navy's Site 03 are located hydraulically upgradient from portions of the Site 16 investigation area. However, the Navy disagrees that this is an evidence that the CVOC plumes from these sites extend to and connect with the CVOC detected at Site 16, based on the available data. Also, please see the Navy's response to EPA General Comment No. 6C.

Comment 6C. Sites 03/PR-58 Recharge and Site 16 Discharge Areas

Review of the groundwater CVOC concentrations from the Site 03 monitoring event reports at first glance would appear to show that significant concentrations of CVOC constituents have not migrated across the area of Site 03 and therefore, could not have arrived in the vicinity of Site 16. However, there is a clear indication of downward vertical hydraulic gradients at the Sites 03/PR-58. These gradients are not all presented in the Groundwater Investigation Report (Table 3-4) and Figures 3-30 and 3-31). Additional vertical gradient data is presented in the Site 03 Monitoring Event 01 Report. That data combined with the data presented in the Groundwater Investigation Report clearly shows that there is at least intermittently, a downward vertical gradient from the shallow to deep groundwater zone and the deep to the bedrock groundwater zone within the Sites 03/PR-58.

Figure 3-31 clearly shows downward gradients from EA114D/R, MW03-14D/R/R2, MW03-12D/R. This figure does not show a downward gradient for EA104D/R for the March 2003 measurement. However, review of Table 2 of the Site 03 Monitoring Event 01 Report shows a very strong downward vertical gradient for that well pair (a downward vertical elevation difference of 1.53 feet) in July of 2000. Figure 3-31 shows an upward vertical gradient for MW03-08D/R and MW03-13D/R for the March 2003 time frame. However, review of the same Table 2 of the Site 03 ME #1 Report shows that there have historically been strong downward vertical gradients recorded for these two well pairs. All of these wells are located within the presumed source area for CVOC contamination. Figure 3-31 does show a downward vertical gradient in March 2003 for MW01-10D/R, EA110D/R, and MW16-55D/R/R2. Further review of Table 2 of the Site 03 ME #1 Report shows that EA111D/R and MW03-03D/R have historically exhibited downward vertical gradients even though the March 2003 levels depicted on Figure 3-31 do not. Therefore, the Sites 03/PR-58 areas are interpreted to be a recharge area with CVOC constituents migrating vertically downward into deeper portions of the site (deep groundwater and bedrock zones).

In regard to discharge zones, it is clear from review of Figures 3-29 and 3-32 that the area of Site 16 is a discharge zone for groundwater. While there is some variability across the site and the gradients are predominantly downward from shallow groundwater to intermediate and deep groundwater zones, several wells show upward vertical gradients from the rock to the deep groundwater zone. Figure 3-29 and Table 3-4 shows upward (discharging) groundwater flow for MW16-15D/R (not shown on Figure but in Table 3-4 for March and May of 2001), MW16-17D/R, MW16-02R/R2, and MW16-44D/R. Figure 3-32 shows upward gradients for MW16-17D/R, MW16-02R/R2, MW16-44D/R, and MW16-27D/R (Table 3-4 also shows upward during March and May 2001). During that time there were neutral gradients for MW16-15D/R and MW16-05D/R. It is also noted that there are relatively few bedrock wells to evaluate flow from the bedrock to the deep groundwater zones. However, review of Figure 3-29 and 3-32 show that groundwater flow from the deep groundwater zone to the intermediate groundwater zone is upward. These include MW16-01, -02, -05, -22, -34, 39, -41, and -45. Therefore, as might be expected given the proximity to the sea, that the Site 16 area does receive discharging groundwater, most likely from Sites 03/PR-58.

Response— Comment noted. Please refer to the related portion of the Navy's 12 November 2003 letter 'Site 16 Hydrogeological Concerns', the Navy's evaluation of concerns presented by EPA during the 11 September 2003 BCT meeting.

Comment 6D. Groundwater Velocity and Transport Time

Although there is very limited data concerning groundwater quality and aquifer characteristics between Sites 03/PR-58 an assessment was made concerning groundwater velocity and likely contaminant travel time from the Sites 03/PR-58. This assessment is made since it appears that groundwater contaminants are migrating downward into the deep and/or bedrock groundwater zones and south of the Sites 03/PR-58 areas and "disappearing" or are somehow degrading under extremely slow groundwater velocities. It is noted though, that there is not sufficient evidence to support significant biodegradation at that area. The data used for the calculations involved the slug test data for the "deep" groundwater zone available from the Phase I and II Remedial Investigation Reports, Site 03 investigations, and investigations of the former Nike PR-58 site. (It should be noted that the values for hydraulic conductivity differ significantly for the same well from the Phase I Remedial Investigation to the Groundwater Investigation-see Specific Comments). The lowest value of hydraulic conductivity was used. Calculations also used the approximate average of hydraulic gradients in the deep groundwater zone.

Slug test data from 12 deep groundwater wells in the Site 03/PR-58 area and 12 deep groundwater wells from the area between MW16-55D to MW16-02D were used. A geometric mean value for each area was calculated and applied to the average

hydraulic gradient in the deep groundwater zone, along with an effective porosity of 0.15. This resulted in travel times of approximately 25 and 20 years, respectively, for groundwater to flow from the vicinity of MW03-14 or EA-104 to near MW16-55D, and from MW16-55D to MW16-02D. This travel time is only an estimate, but does suggest that CVOC contaminated groundwater could have migrated from the Sites 03/PR-58 areas within the time of their being operational.

Contaminant migration velocity was not assumed to be retarded by organic material since the Phase I and Groundwater Investigation data does not indicate significant concentrations of total organic carbon. On the other hand, the contaminant migration velocity was not increased due to dispersion, a process that would extend contaminants forward of any assumed groundwater velocity. Likewise, the velocity could be decreased using a gentler gradient and higher effective porosity. However, the values used could also be changed to reflect a faster velocity. Also, groundwater and contaminants may initially move faster in the shallow and intermediate groundwater which has high hydraulic conductivity values, prior to migrating into the deep and bedrock groundwater zones, thereby providing a "jump start" to CVOC movement. Lastly, there is little hydraulic conductivity data for the bedrock. Groundwater velocities in preferential pathways created by fault/fracture zones would tend to be significantly higher than those used in this analysis, thereby resulting in shorter travel times.

Response— Regarding the statement in this comment that "This assessment is made since it appears that ground-water contaminants are migrating downward into the deep and/or bedrock groundwater zones and south of the Sites 03/PR-58 areas...", the Navy disagrees that the available data show strong and consistent downward gradients at the Sites 03/PR-58 areas and consistent upward gradients at Site 16 to support this. Please see the related portion of the Navy's 12 November 2003 letter 'Site 16 Hydrogeological Concerns', the Navy's evaluation of concerns presented by EPA during the 11 September 2003 BCT meeting.

Comment 6E. Elevated pH Trend in Groundwater

The detection of ethane CVOC constituents in Site 16, groundwater flow patterns, documented recharge and discharge relationships, and sufficient groundwater/CVOC travel time suggests impact to Site 16 from the Sites 03/PR-58 areas. In addition, the distribution of pH in site groundwater also points to the migration of CVOC contamination from those areas to Site 16. Table 2-4 and Appendix E provide pH values of groundwater in wells prior to sampling. In addition, Table 3 of the Site 03 Monitoring Event 02 Report (most recent) also provides pH data for groundwater in wells. The pH in groundwater ranges from a low of 5.24 (MW16-20I) to a high of 12.53 (MW16-32D). The majority of wells appear to exhibit a pH in the range of 5.5 to 6.5. However, a number of wells have pH values above 7.0. Especially noticeable are 9 monitoring wells with groundwater above 8.0. These wells are not close to the

ocean and do not appear to be affected by saline or ocean water. Provided below is a summary table of the monitoring wells that had elevated pH values. These are limited to pH values above 8.0 although there are several wells with values above 7.0 but below 8.0 that also support this trend.

Monitoring Well	Groundwater pH Value
EA110R	8.93
EA111R	11.90
MW55D/R/R2	8.08/11.12/12.37
MW16-32D	12.53
MW16-15R2	12.04
MW16-02R2	12.45
MW16-05R	8.90
MW16-36R	10.25
MW16-54D	10.36

The reason for the observed elevated pH values is not explained in the Remedial Investigation Reports (Phase I or Phase II). It does not appear to be related to ambient soil or rock contribution. However, these wells are primarily bedrock wells with two locations being deep groundwater only. More importantly, the distribution of these wells appears to be aligned from the Sites 03/PR-58 groundwater flow paths to Site 16. Four of the down gradient locations (MW16-32D, MW16-15R2, MW16-02R2, and MW16-05R) are located where there have been elevated detection of TCE.

This pattern suggests that the elevated pH is serving as a tracer of sorts pointing back to the Sites 03/PR-58 area. The reason for this is not certain, but logically appears to be related to the two sites and past activities. The Site 03 Monitoring Event Reports provide information that up to 18,000 gallons of dilute sulfuric acid, at a rate of approximately 60 gallons per month was disposed of in an on-site dry well and/or leaching field via floor drains from IR Program Site 02 from 1955 to 1980. While the report describes dilute sulfuric acid being disposed of through floor drains there is the potential for the dilute acid to have been neutralized, or at least, an alkaline material being added during major spills, or disposed off during close out. The neutralizing material would most likely have been on hand at least for emergency purposes. Even without this occurrence, it is likely that concrete in the floor, within the dry well, and any holding tank would have been degraded with resulting high pH groundwater resulting in the vicinity of the leaching field/dry well.

The second potential source is the former Nike PR-58 site. Reference to a figure for that site shows that there was an area known as an "acid neutralization pit." It is not clear what the construction of that pit was (lined/unlined) or what the volume of acid that was neutralized was, or what neutralizing compounds may have been disposed of at that location or other nearby locations. However, the nature of this type of operation suggests that an alkaline material would have been applied, also with a resultant

increase in groundwater pH when that material was disposed of. Again, as with the battery maintenance area, there would likely be potential for use in emergency situations (spills) or wholesale disposal of the on hand, neutralizing agent during site close out activities.

The detection of elevated pH in bedrock and deep groundwater suggests that alkaline solution released at up gradient Sites 03/PR-58 migrated downward into the deep groundwater and bedrock as indicated by the vertical gradients. Additionally, the presence of the sharply elevated pH at down gradient locations in the Site 16 area indicates that the rate of groundwater migration is fast enough such that the elevated pH in groundwater is being detected in the Site 16 area at the present time. Finally, the distribution of the elevated pH suggests that there is a preferential pathway for groundwater from the Sites 03/PR-58 areas that migrates along Davisville Road with some bifurcation toward the southeast (MW16-54D) as indicated by the groundwater contours shown on the various figures in the Remedial Investigation Report.

Response—Comment noted. Please refer to the related portion of the Navy's 12 November 2003 letter 'Site 16 Hydrogeological Concerns', the Navy's evaluation of concerns presented by EPA during the 11 September 2003 BCT meeting.

Comment 6F. Bedrock Trough Preferential Migration Pathway

Review of the geophysical seismic refraction data along with top of bedrock elevations, determined through rock coring, points to a bedrock structural feature that appears as a lineament along Davisville Road as shown on Figures 2-3 (A, B, C). These figures show the trough terminating at what is depicted as an area of higher bedrock in the vicinity of the intersection of Westcott and Davisville Roads. This is a pronounced feature that may be associated with a fault/fractured zone that was subsequently scoured and possibly filled with coarser material. Even if not filled with coarser material, the lineament would likely still exhibit a higher than average number of fractures, etc. As such, it would provide a preferential pathway for groundwater flow and contaminant migration. This pathway may be what is allowing the movement of the higher pH groundwater from the Sites 03/PR-58 areas to the Site 16 area.

Additionally, while Figure 2-3A depicts an area of bedrock high at the end of the trough, an alternative interpretation can just as readily be made that the trough actually extends through that area to the central portion of Site 16. Review of Figure 2-3A does not indicate that any seismic refraction lines actually crossed this area (as was originally requested by EPA). It should be noted that the interpreted -45 feet elevation at the east end of Seismic Line 02-24 lies in extremely close proximity to the interpreted -20 feet and -25 feet elevations of Seismic Lines 10 and 03. The significance of this is that the ends of the seismic lines that do not cross Davisville Road are further apart. Therefore, if the -45 to -20 feet contours can be inferred to lie

this close together, the distance between the ends of the other seismic lines are too far apart, to definitively draw elevation contours.

This uncertainty is compounded by a lack of soil borings/monitoring wells along this axis of the trough (also previously recommended) to confirm and calibrate the interpreted bedrock elevations and determine rock quality. The bedrock trough shown can easily be extended to roughly similar elevations at monitoring wells MW16-02R (-45 feet), MW16-23D (-40 feet), and MW16-24D (-41 feet), in addition of other wells in the central "onsite" area. Even if there is a steep zone of higher bedrock at the location depicted in the figure, the lack of rock quality data along this axis precludes knowing whether it is relatively highly fractured and therefore, permeable.

Review of Figures 3-21 and 3-26 also support the "hypothesis" that there is a preferential groundwater and contaminant pathway along Davisville road that follows this bedrock trough. Both of these figures show inflection of groundwater contours that have an axis along this trough. This inflection is concave to the down gradient direction and convex to the up gradient direction. The clearest depiction of this is on Figure 3-21 for 18 foot contour (near MW Z3-03), the 17 foot contour near EA110D, and the 16 foot contour near PGU-Z3-10D. This feature is typical of groundwater being "focused" to a zone of higher permeability either a zone of bedrock fracturing or possibly a buried stream channel. Figure 3-26 does not show this as clearly, but would if the 17 foot contour was placed closer to PGU Z3-10D, as it should have been. Figure 3-25 (intermediate groundwater for March 2003) also shows this feature in the vicinity of the former Building 41.

Response— The referenced inflection in the ground-water contour line in Figures 21 and 26 is based on one data point. The field measurements are being checked and the contouring interpretation is being assessed. The 12- and 13-ft contour lines have been drawn too far southwest on this figure toward well MW16-22I and will be corrected in the subject area for the next version of the Phase II investigation report.

Comment 6G. Conversion of 1,1,2,2 PCA to TCE

The absence of 1,1,2,2 PCA in the Site 16 area may be inferred to indicate that there has been no migration of the primary CVOC release at the Sites 03/PR-58 areas. However, review of the data from previous investigations at the former Nike PR-58 site shows that PCA is rapidly converted to TCE in the up gradient source area. Previous comments have noted that PCA has been documented to convert to TCE relatively rapidly through abiotic mechanisms under groundwater environments of neutral to alkaline conditions. The mechanism is dehydrochlorination where a hydrogen atom is removed from the PCA molecule in the presence of excess hydroxyl ions to form water. This causes a double bond to form with the two carbon atoms resulting in TCE with three hydrogen atoms.

The presence of elevated pH discussed above would appear to have provided an ideal environmental condition for this abiotic transformation of PCA. Review of data from the "USACE-NED Characterization of CVOC Contamination Former PR-58 Nike Site, North Kingstown, Rhode Island, February 2001" (Figures 4-2, 4-4 and 4-6) shows this transformation process. This data was collected during September to October 2000. As a result, it represents groundwater quality after several years since the release occurred.

Although it is not certain that MW03-14 is the source area or whether it is indicative of CVOC contamination that has migrated to that location from another release area it provides an example of this process. Figure 4-2 shows the CVOC distribution in the deep groundwater (MW03-14D). The concentration of PCA in the deep groundwater is given as 240,000 micrograms per liter (mg/L). The concentration of TCE is given as 120,000 mg/L. The ratio of PCA to TCE is 2:1. Note that tetrachloroethylene (PCE) was also detected at 3,900 mg/L and 1,1,2 TCA was detected at 2,800 mg/L. Both PCE and 1,1,2 TCA were detected in the groundwater at Site 16 at low concentrations.

Figure 4-4 shows the concentrations of PCA and TCE in groundwater in the bedrock at MW03-14R. The concentrations of PCA and TCE are 7,500 mg/L and 10,000 mg/L, respectively for a PCA to TCE ratio of 0.75. Figure 4-6 shows the relative concentrations deeper in the bedrock at MW03-14R2. PCA has disappeared from the groundwater while TCE remains around 10,000 mg/L. Also of note, the concentrations of 1,1,2 TCA, 1,1, DCA, and PCE have been significantly reduced, although present. Their concentrations are similar to what observed at down gradient locations in the Site 16 area. This vertical trend at one location is also noted down plume where PCA concentrations reduce and TCE increases as you move in the downgradient direction. Therefore, it appears that PCA released in the Sites 03/PR-58 source areas is readily converted to TCE such that little if any PCA may be observed when groundwater migrates some distance down gradient.

Response— Comment noted. However, the vertical hydraulic gradient data do not support the hydraulic mechanism presented earlier in this comment to connect the deep CVOC plume from Sites 03/PR-58 to Site 16. Please see the related portion of the Navy's 12 November 2003 letter 'Site 16 Hydrogeological Concerns', the Navy's evaluation of concerns presented by EPA during the 11 September 2003 BCT meeting.

Comment 7: Railroad Spur Release Area;

Data contained in the Phase I Remedial Investigation Report suggested that there may have been a release of CVOC material in the railroad spur area to the east of the location of the former Building 41, near MW16-37. This possibility was indicated by elevated membrane interface probe electron capture device (MIP-ECD) response

(Phase I Figure 2-4). During the Phase I investigation “mid” level responses were noted at MIP16-S10 (28-50 feet) and MIP16-S21 (16-22 and 28-34 feet). A “very low” response was noted at MIP16-S22 (10-11.5 Feet). Several additional MIP-ECD responses were noted ranging from “low” to “high” in the proximity of these shallower detection intervals, but at intervals still above the deep groundwater zone. TCE had also been detected in two soil samples (Phase I Figure 4-1) from nearby SB16-29 (20-22 and 32-34 feet).

The Phase I investigation lacked shallow and intermediate groundwater monitoring wells in this area to assess the CVOC concentrations in groundwater and to refine groundwater flow directions. The results of the Phase II investigation found significant concentrations of CVOC material at two locations (MW16-37 and MW16-38) in the shallow and intermediate groundwater zones. TCE was detected in groundwater from MW16-37S, MW16-37I, and MW16-38I at concentrations ranging from 840 to 1,200 mg/L. This indicates that there is a strong possibility of a release in this area. Contamination might possibly have migrated with groundwater and along the bedrock surface to the locations where it is now observed at higher concentrations in groundwater, particularly MW16-14, MW16-15D, and MW16-32D.

However, the release in the vicinity of MW16-37 may not be the primary contributor of CVOC contamination noted at those mentioned well locations, or other locations. Review of the groundwater flow directions for the shallow, intermediate, deep and rock groundwater zones as depicted on Figures 3-19 to 3-27 show that the direction of flow from MW16-37 is to the east or slightly to the east-northeast. The locations of MW16-14D, MW16-15D, and MW16-32D all lie to the north from the MW16-37 location.

MW16-38I does lie to the east of MW16-37, in the direction of groundwater flow, and did have elevated concentrations of CVOC material detected in the groundwater. The concentration of CVOC material detected in the groundwater at this location is similar to that at MW16-37I, but significantly less than the concentration of CVOC detected in groundwater at the monitoring wells located to the north, or cross gradient from the MW16-37 location. If CVOC transport through groundwater was responsible for the observed concentrations at MW16-14D, MW16-15D, and MW16-32D, then concentrations would likely be less than that observed at MW16-38I.

It is possible, though, that CVOC migrated vertically downward and then along the bedrock surface in a cross gradient direction. Review of the information contained in this report does not provide strong support for this interpretation. Figure 2-3B shows that there is a bedrock high between the location of MW16-37 and MW16-14D, MW16-15D, and MW16-32D. This condition would appear to prevent migration of dense, non-aqueous phase liquid (DNAPL) from moving from MW16-37 to those wells to the north. Also, the concentration of CVOC detected in MW16-37D was relatively low at 21 mg/L. If significant CVOC had migrated to depth prior to

migration along the bedrock surface, there would likely be higher concentrations of CVOC in groundwater at MW16-37D, given the present concentrations detected at MW16-37S and MW16-37I. Therefore, it is not clear that significant CVOC contamination migrated to depth at the location of MW16-37D to begin with.

Review of the soil boring logs for MW16-37 and MW16-38 are also inconclusive of a surface release at this specific location. The log for MW16-37D does not indicate a response on the flame ionization detector (FID) during sampling of the upper 24 feet of the soil column. There is a response over the 24 to 38 feet intervals except that with a filter, the response is non-detect. The soil log for MW16-38I did not indicate any response on the FID with or without a filter throughout the entire length of the soil boring. It is also not clear what is occurring in this area. It is possible, however, that a past release occurred in this general area, but not at these exact locations.

Review of Figures 4-5 and 4-8C show relatively elevated concentrations of tetrachloroethene (PCE). At MW16-33I PCE was noted at 25 mg/L. Further down gradient at MW16-34D, PCE was detected at 23 mg/L. PCE is detected at several locations in the south and western portion of Site 16 and may be related to the documented release of PCE in the Sites 03/PR-58 area. PCE has been detected at those locations at up to 3,900 mg/L in MW03-14D (along with much higher concentrations of PCA and TCE) during the September to October 2000 sampling. Review of groundwater flow directions from Figures 3-19 to 3-28 does show that the direction of groundwater flow migrates through the area of MW16-33I and MW16-34D also. Review of Figures 3-29 and 3-32 indicates that there are times at which the vertical gradients are either neutral or upward for various stratigraphic intervals (shallow to deep, shallow to intermediate, etc.) at the PR-58 locations and MW16-37.

Alternatively, there may be another undocumented release of PCE in the vicinity of Building 39 and 318 that is contributing to this occurrence. Review of the soil log for MW16-34D indicates that there was detection with the FID including while using the filter from the 8 to 14 feet below ground surface interval. This interval is just at the groundwater table. The soil log for MW16-33D, however, did not have any recorded FID detector response throughout the soil column.

Also, the log for MW16-17D indicated a low-level response on a photo-ionization detector (PID) over nearly the entire soil column starting at the ground surface. It is possible that this may represent an additional release at this location. The general flow of groundwater from this location is to the east and southeast away from the area of MW16-37I/D and MW16-38I where elevated TCE was detected in the groundwater. This suggests the possibility of CVOC constituents migrating to the east and southeast from the MW16-17 location. While no significant levels of CVOC compounds were detected in groundwater at MW16-17 S/I/D, it is noted that in the most direct downgradient location from MW16-17D there are currently no monitoring wells. Additional work may be needed to fill this data gap.

Review of this information (soil column FID/PID detection) and the distribution of CVOC as shown on Figures 4-3, 4-6, and 4-9 suggests an as yet, undefined release in the vicinity of MW16-37S/I/D and/or MW16-33I that migrates toward the east. The concentration contours shown on Figures 4-3, 4-6 and 4-9 are incomplete and are made difficult to draw due to the likelihood of multiple inputs to the CVOC contamination in the groundwater along Davisville Road between the central "onsite" area and east of the location of the former Building 41. It is likely that the groundwater in this area receives CVOC contaminants from several locations resulting in cumulative concentrations. However, the elevated detection at MW16-39I and MW16-39D coupled with the groundwater flow directions inferred on the groundwater elevation figures indicates that the release in the railroad spur area migrates toward the east.

Response— Comment noted. As stated in the Draft Phase II Hydrogeologic Investigation Report, the deep CVOC plume area appears to have developed from contributions of 5 potential source areas, including the area near MW16-37 and MW16-38 in the railroad spur area south of former Building 41. Regarding the statements about detected PCE, potential for a release in the vicinity of Buildings 39 and 318, and potential for a release area between well clusters MW16-33 and MW16-37:

- PCE, when detected, is typically detected at concentrations less than 2 µg/L, except in samples from MW16-33 and MW16-34, where the maximum detected concentration was 25 µg/L. Additionally, PCE was not detected in the samples collected from wells completed in bedrock, neither the R nor R2 zones.
- While the interpreted ground-water flow direction data indicate that Building 39 may be upgradient from a portion of the former railroad spur area, the same data indicate that Building 318 is typically cross-gradient or slightly downgradient of the former railroad spur area. Therefore, the Navy disagrees with statement that there is an undocumented source in the vicinity of Building 318 that is contributing to the CVOC detected in samples collected from wells located in the former railroad spur area.

Comment 8: Central "Onsite" Area Source Areas;

EPA interprets the Site 16 Remedial Investigation Report data as being indicative of a potentially significant contributing input to Site 16 groundwater contamination from the Sites 03/PR-58 area and a likely lesser impact from a past release in the railroad spur area. The data also supports a significant input to groundwater contamination from releases in the area bounded by Westcott, Davisville, and Allen Harbor Roads. There have likely been multiple releases of CVOC constituents within this area. In fact, releases from this area appear to have been widespread throughout the delineated area. In particular, these releases are also likely to exist in the southeastern quadrant of

the "onsite" area where there has been an absence of soil borings and monitoring wells.

The data from the Groundwater Investigation Report indicates two major past releases at the Former Fire Training Area (FFTA) and an area along the southern portion of the "onsite" area near Davisville Road. Data from the Phase I Remedial Investigation also supports a possible release in the southeastern portion of the "onsite" area as indicated by MIP16-24 located to the east of MW16-42. This location was not sampled during this remedial investigative effort even though a groundwater monitoring well pair here was previously recommended by EPA.

Comment 8A. Former Fire Training Area Source

Review of the data shows that there has been significant release(s) of CVOC compounds in the area designated as the FFTA. The releases are likely to have been much more widespread than just at MW16-45 as implied by the Groundwater Investigation report. Soil boring logs also show that this area has received fill material, similar to landfill operations. Documentation of releases within and immediately around this area is provided by the results of groundwater sampling and analyses from MW16-43S/I/D, MW16-44S/I/D, MW16-45S/I/D, and MW16-46S/I/D. Shallow groundwater at each of the locations contains low levels of CVOC contaminants and fuel-related contaminants including benzene, toluene, ethyl benzene and xylenes (BTEX).

While each of the shallow groundwater samples has only trace concentrations of TCE, there are somewhat higher concentrations of degradation products of TCE including cis-1, 2 DCE and vinyl chloride. This may be expected for the shallow groundwater where there has been flushing of organic compounds over time due to precipitation and volatilization. Nonetheless, the distribution and presence of these concentrations of residual CVOC (and BTEX) constituents over an extended period of time since last operational use of the site indicates that significant quantities of these materials were released at this location. These materials were most likely released due to either waste disposal in the documented fill material, and/or as a fuel to accelerate the fires for fire suppression training.

Due to precipitation over a site, especially one that did not have significant vegetative cover during the time of operations, and with sandy soil, the CVOC contaminants (and BTEX) would be expected to migrate vertically downward in addition to horizontally. Review of the groundwater sample results from the intermediate groundwater zone for the listed wells shows that this is the case. The concentrations of CVOC constituents (and BTEX) in the three wells immediately around the central FFTA (MW16-45S/I/D) have low levels of those constituents. However, groundwater from MW16-45I has strongly elevated TCE at a concentration of 820 mg/L. This is indicative of

downward vertical migration of a past release of significant quantity of chlorinated solvent at this location.

Review of the results for the deep groundwater zone shows that all four of the wells in and surrounding the FFTA have elevated concentrations of CVOC material ranging from 360 mg/L at MW16-46D to the northeast to 770 mg/L at MW16-43D to the southwest. A concentration of 660 mg/L was found for MW16-44D to the southeast while the groundwater at the central location had 760 mg/L at MW16-45D. This clearly demonstrates downward vertical migration of CVOC. The higher concentrations are the result of flushing and migration over time combined with lower rates of biodegradation as the co-metabolic BTEX compounds are reduced in concentration such that reduction of CVOC constituents is reduced.

The detection of elevated TCE in the three deep wells surrounding MW16-45D indicated radial flow of TCE in groundwater from the release area. The groundwater contours presented in the various figures in the Groundwater Investigation report show a predominant direction of flow to the northeast in the "onsite" area. (There is some uncertainty in the shallow groundwater contours in this area depicted on Figures 3-19 and 3-24 that appears to show more radial flow). Nonetheless, review of the various cross sections provided and additional cross sectional segments sketched during assessment of the Groundwater Investigation show that there are sloping stratigraphic layers that originate in the vicinity of the FFTA and slope outward in a semi-radial fashion to the northeast, southeast and south. Inspection of the soil logs and cross sections shows that there are varying thickness of the underlying presumed low permeability silt and silt-sand layers along with discontinuities that can allow vertical migration of DNAPL through to the bedrock.

Inspection of the inferred bedrock topography for the central "onsite" area also shows that the bedrock surface slopes to the east, southeast and south with a significant bedrock depression at the locations of MW16-42 and MW16-02 to the southeast. Therefore, while DNAPL can migrate along the dipping silt layers it can also migrate along dipping bedrock surfaces. These surfaces at some locations within the "onsite" area run cross gradient to the depicted groundwater flow directions in addition to paralleling them at places.

Inspection of cross sections A-A' and B-B' clearly show the sloping nature of the silt layers and the bedrock surface from the vicinity of the FFTA to the east. These cross sections also show the discontinuity of the silt layer across the site down gradient from the FFTA. There are high concentrations of CVOC constituents noted in monitoring wells MW16-05 (A-A') and MW16-29 (B-B'). Neither of these cross sections includes monitoring wells MW16-44 or MW16-45. When these logs are superimposed on these cross sections and/or new cross section segments are sketched from those locations to MW16-05 and MW16-29 it strongly suggests that the CVOC

constituents observed at those locations most likely originated, at least in part, from the FFTA.

Evaluation of other cross sections including L-L' and M-M' show sloping bedrock from the vicinity of the FFTA to the south and southeast and an absence of a low permeability silt layer (MW16-41 and MW16-42). This stratigraphic configuration becomes even more apparent when either additional, adjacent wells are superimposed or separate cross section sketches are prepared. For instance, when a cross section is drawn from MW16-45 to MW16-44 to MW16-42 to MW16-02 this configuration becomes very apparent. Also, the same absence of low permeability layers and the presence of sloping bedrock is even more apparent when constructing a cross section sketch from MW16-43 to MW16-41 or MW16-42 to MW16-02. When the CVOC concentrations are superimposed onto the various groundwater monitoring well intervals it strongly suggests the downward vertical migration of CVOC contaminants in the FFTA and subsequent migration along the bedrock to the south and southeast in addition to the northeast and east as described above. As a result, EPA believes the observed TCE contamination observed at MW16-02, and in the surrounding monitoring wells is most likely due to release(s) from the FFTA.

Response— Comment noted. The Navy agrees that, generally, the vertical hydraulic gradients observed at monitoring wells located around the FFTA are predominantly downward. However, based on the Interpreted Bedrock Surface Contour Map (Figure 2-3C in the draft Phase II report), gravity flow along the bedrock surface would be in an easterly direction from the FFTA. Therefore, while the FFTA may provide a small contribution to the detected CVOC at MW16-02, ground-water flow in this area is predominately from the southwest, and would likely indicate that at least some of the CVOC at MW16-02 is coming from potential historical releases around the northeastern portion of former Building 41, plus potential historical releases somewhere closer to MW16-02.

Comment 8B. Southern Boundary Area Source

Review of the soil boring logs for MW16-40S, MW16-41S/I/D, and MW16-42S/I/D show that a separate release occurred in the southern portion of the central "onsite" area along Davisville Road. EPA interprets the release in this area to be major and significant. The FID detection responses were very elevated beginning at or near the surface in all three, soil borings. The elevated detector responses were usually with the FID filter in operation. Figure 4-2 shows that all of these wells had significant concentrations of CVOC constituents (and presence of BTEX) in the shallow groundwater zone. For two of the wells, MW16-40S and MW16-41S, the CVOC concentrations were significantly higher than in the FFTA shallow groundwater. There were also relatively high concentrations of cis-1, 2 DCE and vinyl chloride, indicating an old release that has undergone degradation, most likely as a result of joint release with petroleum hydrocarbons (BTEX) that provided a co-substrate for the

degradation of the CVOC. Nonetheless, the relatively high residual concentrations of CVOC in the shallow groundwater suggest a significant past release within this area.

Figures 4-5 and 4-8A show a continual downward progression of the released CVOC material to the intermediate and deeper groundwater zones in MW16-41 and MW16-42 (no deeper wells were installed at MW16-40). At MW16-42I the CVOC constituents are cis-1, 2 DCE and vinyl chloride indicating continued degradation at that location while at MW16-41I the CVOC is primarily TCE. For both deep wells, there is an elevated level of TCE with the highest concentration being detected at MW16-42D (990 mg/L). Although there was no intermediate or deep monitoring well installed at the location of MW16-40S, a nearby well, MW16-08D had elevated levels of TCE at 140mg/L.

The release(s) at this area are likely superimposed onto the release(s) from the FFTA. Assuming that groundwater flows predominantly to the east, the release(s) from this area also likely contribute to the observed CVOC contamination noted at MW16-02I/D/R. However, as with the contamination released in the FFTA there is the potential for chlorinated compounds to migrate along low permeability lenses and the bedrock surface. Review of cross sections H-H', K-K', and L-L' suggest that this has occurred.

Cross section H-H' shows the silt layer dipping to the south from MW16-41 to MW16-40 with a break and an additional silt layer at a lower elevation dipping toward MW16-23 and MW16-21 and ultimately to MW16-25 where there is no silt layer. Cross section K-K' shows what can be inferred as a silt layer dipping to the south between MW16-08 and MW16-22. Cross section L-L' shows a silt layer dipping south from MW16-42 to MW16-24, with a gap between MW16-42 and MW16-02. (The presence of a dipping silt layer from the central "onsite" area to the south is further supported by examination of cross sections F-F' where the silt layer dips from MW16-01 to MW16-22 and MW16-21, with the subsequent break at MW16-25. This dipping silt layer is also present in the cross section J-J' where the silt layer dips from MW16-13 to MW16-33). Therefore, it appears that DNAPL may have migrated to the south along the silt layer to the vicinity of MW16-25 where the silt layer is absent and then down to the bedrock.

This pathway is further supported by the presence of BTEX constituents in many of the deep groundwater zone wells. Review of Figures 4-2, 4-5, 4-8A, and 4-8C supports this interpretation. Shallow zone groundwater in the "on-site" area (Figure 4-2) has widespread BTEX detection, albeit at relatively low levels. Low concentrations are expected given the biodegradability of BTEX and the time since release(s) occurred. However, none of the shallow groundwater wells in the area south of the "onsite" area had any detection of BTEX. Review of Figure 4-5 though, shows BTEX constituents in several wells in the intermediate groundwater zone to the south of the central "onsite" area in addition to the intermediate wells in the "onsite" area. Figure

4-8A shows that BTEX is still present in several wells in the deep, groundwater zone in the "onsite" area. Figure 4-8C, though, shows the presence of BTEX constituents in a number of deep groundwater zone wells, particular, those to the south of Davisville Road. This distribution of BTEX constituents may be viewed as a tracer indicating the migration of CVOC constituents and associated trace amounts of residual BTEX compounds to depth with migration along dipping silt and/or bedrock layers, at times possibly cross gradient to groundwater flow. Therefore, it is likely that the observed TCE contamination noted in groundwater to the south of the "onsite" area is partially the result of release(s) from the "onsite" area.

Response— Comment noted. As stated in the Draft Phase II Hydrogeologic Investigation Report, the detected CVOC plume area appears to have developed from contributions of at least 5 potential source areas, including the area near MW16-40S. The Navy assumes that the gravity flows along downward sloping silt layer surfaces (referred to in this comment) would be DNAPL that would leave a path of residual DNAPL that, in turn, would result in ground water with very high CVOC concentrations. However, where there are wells screened at the top of these referenced silt layers (MW16-21I, MW16-22I, and MW16-24I), the detected total CVOC concentrations in ground-water samples were only 14.26 µg/L, 195.15 µg/L, and 41.82 µg/L, respectively.

Comment 8C. Southeastern Boundary Area Source

This Groundwater Investigation does not specifically address potential release(s) in the southeastern portion of the "onsite" area. MW16-42S/I/D is the only well in the southeastern quadrant. However, that well did have elevated concentrations of CVOC material and high FID detection results throughout a large portion of the soil column. Additionally, it was noted to have the deepest bedrock elevation with extremely weathered and fractured rock. The "competent" rock had a rock quality designator (RQD) value of 7%. In addition to being within a likely release area and potentially receiving CVOC contamination from the FFTA, it may also have received CVOC contaminants from the area to the east, inferred groundwater flow directions notwithstanding.

What appears to be vegetative stress is noted for the southeastern boundary of the "onsite" area. This area may be vegetated, but for some reason appears to be different from other vegetated areas of the "onsite" area. Significantly, as noted by EPA during the comments on the Phase I Remedial Investigation, this area is also the location of the MIP probe MIP16-24 groundwater sampling. This location is over 100 feet to the east of the MW16-42 well location. The groundwater sample collected from MIP16-24, at 47 feet below the ground surface, contained 5,000 mg/L of TCE and 550 mg/L of cis-1, 2 DCE. These concentrations are among the highest recorded for groundwater at Site 16. By way of comparison, MIP16-17, which is located near the present MW16-42 had detection of approximately one-tenth the CVOC levels at the same groundwater interval. EPA had initially recommended installing an additional

monitoring well pair (intermediate and deep) at this location. This recommendation was not implemented.

This area poses the possibility of being another significant CVOC release area in addition to the FFTA and the southern boundary area along Davisville Road. First, the bedrock topography shown on Figure 2-3B shows a substantial depression to the west of this location (MW16-42 and MW16-02). Even if groundwater flow is consistently to the east across this location, DNAPL release in this area has the potential to migrate westward along the bedrock surface to the vicinity of MW16-42 and MW16-02. The description of MW16-42 and MW16-02 in various logs suggests that these locations may be significant inputs to deep groundwater zone contamination. MW16-02R was described in the geophysical testing Appendix L of the Phase I Remedial Investigation to have "odor from bore hole similar to diesel fuel." Combined with the vertical downward gradient from the deep to rock and low RQD values, this location has the potential to be a sink for CVOC contamination from the southeastern quadrant and being a point of introduction to the deep groundwater zones including bedrock at other locations.

The lack of a monitoring well in this area also limits the resolution of groundwater flow patterns. For instance, review of Figure 2-19 shows that the shallow groundwater flow in this quadrant is undefined. This figure provides shallow groundwater elevations of 9.86 feet for MW16-44S and PGU-Z3-09S. Monitoring wells MW16-40S and MW16-42S have elevations of 9.48 and 9.43 feet, respectively. There was no water level recorded in MW16-02S. Water was reported to be below the top of the pump at the time of groundwater level measurement. Review of the well construction log suggests that this elevation would be significantly lower than 9 feet. This groundwater level also indicates that there is radial groundwater flow from the center of the "onsite" area through the southeast quadrant, at least at intermittent times.

Response— The Navy proposes to install a monitoring well cluster in the vicinity of the former MIP16-24 location. However, the Navy disagrees with the statement that "MW16-42S/I/D is the only well in the southeastern quadrant." Well cluster MW16-02S/I/D/R/R2 is also located within this quadrant.

Comment 9: Natural Attenuation Assessment;

Information pertaining to and evaluation regarding the applicability of natural attenuation is provided in the Phase II Remedial Action Report. However, detailed comment and discussion concerning natural attenuation and potential applicability for this site is not provided in this review. The main reason is that evaluation of the potential for natural attenuation to be ongoing and a valid site remedial alternative requires that the source area and contaminant migration pathways be defined. Based upon the review of the information contained in the Phase I and Groundwater Investigation reports this has not been definitively and coherently accomplished. As a

result, it is impossible to define "background," routes of migration to establish potential plume dynamics (advancing, steady state, or receding), and what specific source areas require removal or stabilization (a natural attenuation requirement). Therefore, it is premature to provide in depth evaluation and assessment.

However, several comments are made in reference to the general chemical data provided. The data provided on Table 4-9 supports the analysis made by EPA that the "on-site" area is a major source area. Review of Table 4-9 shows that the areas with the highest methane concentrations lie in this area. The highest concentrations were at MW16-04S, MW16-42S, and MW16-46S. Somewhat lower concentrations were detected at MW16-02S, MW16-03S, MW16-05S, MW16-07S, and MW16-40S, MW16-41S, MW16-43S, MW16-44S, MW16-45S, and MW16-48S. These locations are within the "onsite" area boundaries. Shallow groundwater outside this area did not have any methane detected. Elevated concentrations of ferrous iron and depletion of nitrates and sulfates were also generally limited to those areas.

Review of the data for the intermediate groundwater zone follows the same pattern with the highest ferrous iron concentrations noted for MW16-02I, MW16-42I, MW16-43I, MW16-44I, MW16-45I, and MW16-46I. The largest decline in nitrate and sulfate terminal electron acceptors was also noted in those wells. Elevated methane was virtually absent from all wells with one notable exception, MW16-42I. MW16-05I, MW16-43I, MW16-44I, MW16-45I, and MW16-46I had detectable, but relatively low levels. The significance of this is that MW16-42I is located in the area of the bedrock low and in close proximity to MIP16-24. MW16-42S/I/D has indicated significant concentrations of CVOC constituents from the shallow to deep groundwater zones.

Further, significant biodegradation of TCE does not occur without an organic co-substrate. At fire training areas and similar sites the co-substrate is often petroleum hydrocarbon fuel compounds which are relatively biodegradable. As indicated by the trace concentrations of BTEX constituents throughout the "onsite" area in shallow, intermediate, and deep groundwater, this is likely the case at this site. This is a location where biodegradation can occur, to a point. This is borne out by the presence of cis-1, 2-DCE and vinyl chloride in MW16-42S/I. However, in the deeper groundwater zone, TCE is significantly elevated with minimal presence of degradation products. This indicates that the petroleum hydrocarbon co-substrate (BTEX) was exhausted at this location. Of note though, the presence of a co-substrate to facilitate at least some biodegradation implies that BTEX compounds (and other materials) were released in the southern boundary area of the "onsite" area, not just the "fill" area or the FFTA. Also, it is reiterated that during the construction of MW16-02R during the Phase I Remedial Investigation an "odor like diesel" was noted in the open hole. Diesel is a major fuel for military vehicles and equipment and could have been released in this area along with other material. Therefore, EPA interprets this natural attenuation data combined with the MIP16-24 and MW16-42SID, MW16-02I/D/R

and other data to indicate that there was a major release of fuel in the vicinity of the southern "onsite" area along Davisville Road and the southeastern, unmonitored quadrant.

Caution should be applied when interpreting the terminal electron acceptors within disposal areas especially areas known to be landfill. For instance ferrous iron concentrations can be a function of iron bearing material placed into the site. Also, where there is evidence of biodegradation, it does not necessarily mean that the chlorinated compounds are degrading. Consumption of dissolved oxygen, nitrates, sulfates, ferric iron, and generation of methane will occur due to the biodegradation of ordinary organic matter including petroleum hydrocarbons, buried brush, etc. Also, the initial concentrations of certain electron acceptors may not be uniform throughout the aquifer. Nitrates, for instance, may be limited to shallow or intermediate groundwater where it has been introduced due to fertilizer, septic leaching fields, or precipitation. Elevated sulfate may be derived from the deposition of certain materials in fill and/or the application of wastewater sludge or other material.

As an example, MW16-06S/D, a presumed up gradient "background" well has nitrate at 4.01 milligrams per liter (mg/L) in the shallow groundwater. However, there is not any nitrate in the deep groundwater. The scoring sheet on Table 5-2 calls MW16-10R a "background". If this is so, the nitrate concentration in this "background" well is non-detectable. It is noted that there were septic systems in use near Building 107 and 41. The sulfate concentration is 11.6 mg/L in the shallow well and 22.80 mg/L in the deep well. However, within the "onsite" area, sulfate concentrations at MW16-42S is 47.5 mg/L. The disposal of wastewater to the associated leaching fields can provide non-uniform input of nitrates and sulfates into the groundwater at those locations. Thus, the observed depletion of those electron acceptors can be misleading.

The scoring sheet constructed and presented on Table 5-2 is, therefore, subject to interpretation. In addition to the issue of terminal electron acceptors, certain parameters used to generate positive scores may not be related to CVOC loss. The presence or absence of nitrates, as shown above, does not necessarily indicate microbial activity. Methane can accumulate from a variety of sources, especially in areas of peat, or buried organic waste (non-chlorinated). Similarly, the concentrations of dissolved iron, concentrations of sulfate, etc. need to be assessed in complete context of what their origins are.

Review of Table 4-9 does not show significant concentrations of end products of CVOC degradation in the groundwater. Only MW16-15R showed any detection of ethylene (it also showed the presence of ethane, a degradation product of 1,1,2,2 TCA). The presence of vinyl chloride and cis-1, 2 DCE is limited to the shallow and intermediate groundwater intervals and is not present in the deep and rock groundwater zones where TCE has been detected at high concentrations. Monitored natural attenuation may ultimately be a valid remedial alternative for this site, but not

at the present state of knowledge of Site 16, however, more data collection is necessary before this can be agreed to.

Response— Comment noted. The Navy requested an assessment of monitored natural attenuation, using existing data, to evaluate the potential for and efficacy of natural attenuation processes, such as intrinsic biodegradation, to attenuate the observed dissolved CVOC contamination. This preliminary assessment can be viewed much like a treatability study, a natural part of the RI process, to support the future FS process. Toward that end, it is not too early to perform such a preliminary assessment to support the RI/FS iterative process of data collection to support the selection of remedial alternatives. In addition, the use of downgradient ground-water plume management strategies, such as monitored natural attenuation, are often preferred remedial options when source complexities, such as the case with Site 16 sources, are evident. Also, the Navy has not requested agreement with monitored natural attenuation at this time. The Navy's proposed remedy will be included in the Proposed Remedial Action Plan. EPA's concurrence will be requested on the Record of Decision.

With respect to the above comment that the interpretation of electron acceptor data can be misleading, the technical protocol was developed by AFCEE and the EPA for site-specific electron acceptor anomalies through the use of 29 weighting criteria and is widely accepted. Therefore, a single or even multiple anomaly(s) will likely be normalized by the weighting process. For the case of this assessment, a total of 31 wells were analyzed in the scoring process. Two background wells, MW16-10D and MW16-10R, were utilized to compare in-plume data from representative water-bearing zones to background data.

SPECIFIC COMMENTS

Comment 10: P1-2, §1.1.1, NCBC Davisville Description and History, EFANE should also be working closely with the Town of North Kingstown. The Town is planning to lease the area from Davisville Road north to the Harbor from the RIEDC. The Allen Harbor Master Plan indicates that this area will be used for Marina support facilities.

Response— Comment noted.

Comment 11: P1-2, §1.1.2, Site Description and History, please add trees to the description of the vegetative cover as Tamaracks are not shrubs.

Response— The text has been changed as follows: In the past, this area was extensively bulldozed and disrupted during training exercises, but now has a vegetative cover of trees, shrubs and grasses.

Comment 12: P1-4, §1.1.2, Site Description and History, first partial sentence, P6-3, §6.1, Potential Contaminant Source Areas, and P6-12, §6.7, Recommendations, since groundwater flows to the south east from building E-319 and the Navy moved the activities from building 41 to building E-319, the Navy should investigate the area to the southeast of building E-319 to determine if there has been a release at E-319.

Response— The Navy is not aware of any reported releases associated with past uses of Building E-319. Building E-319 was previously addressed as EBS Review Item Nos. 58 and 79, which were determined to require no further action.

Comment 13: P1-20, §1.2.6.4, Nature and Extent of contamination in Soil, EPA's conclusions from the Phase I RI state that additional soil sampling was necessary to fully characterize the soils and sediments. Please change the first sentence to state, "Based on the limited soil sampling done in the Phase I RI, a Phase II RI was planned. The available RI data detected....."

Response— The text has been changed as follows: Based on the limited soil sampling performed during the Phase I RI, a Phase II Hydrogeological Investigation was planned. The detected concentrations of VOC, SVOC, pesticides, and PCB do not exceed the RIDEM Residential Direct Exposure Criteria.

Comment 14: P1-20, §1.2.6.5, Nature and Extent of contamination in Groundwater, EPA's conclusions from the Phase I RI state that additional groundwater sampling was necessary to fully characterize the groundwater. Please change the first sentence to state, "Based on the results of the Phase I RI, a Phase II RI was planned. The available RI data indicated that the predominant....."

Response— The text has been changed as follows: Based on the Phase I RI data, a Phase II Hydrogeological Investigation was planned. The available data indicated that the predominant contamination identified in ground water is a plume of dissolved CVOC, particularly TCE, in the deep overburden and upper competent bedrock ground-water zones (Appendix A, Figures 4-32 and 4-35).

Comment 15: P1-22, §1.3, Objectives of the Phase II RI, please include "Characterization of soils, sediments, and groundwater to support a baseline HHRA and ERA" as an objective of the Phase II RI. This report doesn't meet that objective, an RI must include a risk assessment. Please change the title of this report to a groundwater investigative report or something similar rather than an RI which it is not.

Response— Please see the Navy's response to EPA General Comment No. 1.

Comment 16: P 3-19, §3.8, Land and Resource Use, last ¶, The Town did inform RIEDC of the plan to install a forced main sewer line, however, RIEDC did not inform the Navy as they were required to under their lease. Please change the sentence in question to

state, "...without prior notification to the Navy." In addition, please add that an annual meeting between the Navy and current landowners is planned to discuss future projects, so that this doesn't happen again.

Response— The text has been changed as follows:

The initial annual LUCIP (Institutional Control) inspection of Parcel 7, which includes Site 16, occurred on 20 November 2001, followed by a second inspection on 13 December 2002. Based on these Institutional Control Inspections, there was compliance with the institutional controls stated in the LUCIP (EA 2002c) placed on this parcel. However, the Town of North Kingstown excavated and installed a forced main sewer line through the northern edge of Site 16. This work was done without prior notice to the Navy through RIEDC. During the 14 March 2002 BCT meeting, the EPA representative notified the Navy that they had observed this excavation that day. The Navy then notified the RIEDC of their (the Navy's) knowledge of the excavation activity by telephone and letter requesting a meeting to discuss better coordination of any work being conducted at this parcel. The excavation was adjacent to two of the Navy's monitoring wells. However, these wells did not appear to be damaged and there were no apparent site-related health or safety concerns to the excavation workers. The meeting resulted in better communications between the related parties to preclude re-occurrence of such a situation. Annual meetings between the Navy and the current landowners are planned to discuss future projects to minimize this occurring again.

Comment 17: Page 5-17, First Paragraph: This paragraph refers to Table 5-2 as a summation of the potential for biodegradation for CVOC constituents in the various groundwater zones including shallow, intermediate, deep, and rock. However, Table 5-2 only presents results of the scoring for the rock zone. Scoring for the other groundwater zone locations should be provided according to the text.

Response— Comment noted. Monitored natural attenuation scoring for the shallow, intermediate, and deep zones was inadvertently left out of the document. The scoring for these additional zones will be added to the next version of the Phase II Hydrogeological Investigation Report, as requested.

Comment 18: Pages 5-19 through 5-21: It is not clear what is trying to be stated in these sections on redox zonation. Review of Figures 5-2 through 5-5 shows areas of various reduction zones although there appear to be inaccuracies when compared to the data provided in Table 4-9. Is the interpretation of redox zone meant to mean only those areas with negative oxidation-reduction potential? If so, why is there the presentation of Figures 5-2 through 5-5 and no figures showing the distribution of ORP results?

Response— The interpretation of redox zones in Figures 5-2 through 5-5 is not meant to indicate only the areas of negative oxidation reduction potential. These figures show, for all water bearing zones, areas of both negative and positive oxidation reduction potential. Redox conditions, negative or positive, vary greatly with depth and spatial location. In general, positive redox conditions are evident in the shallow water bearing unit, and conditions become negative with depth.

The interpretation of redox zones is presented to evaluate the potential for intrinsic biodegradation and chemical reduction. As shown in the literature, biological and chemical reductive dechlorination of CVOC will occur under moderately to strongly negative redox conditions. Therefore, Figures 5-2 through 5-5 are presented to provide a qualitative view of where redox conditions may be conducive to promote reductive dechlorination, given that the right combination of electron donors and electron acceptors are present.

The determination of redox conditions in Figures 5-2 through 5-5 was made through assessing the series of biodegradation reactions that typically occur during intrinsic biodegradation, and determining the electron acceptor that is currently active as a function of depletion of other electron acceptors. The concentration of given electron acceptors was compared to background levels, documented in ground water from MW16-10D and MW16-10R, to determine preferred electron acceptor depletion and, therefore, the appropriate electron acceptor and biodegradation reaction currently employed in localized areas. Therefore, the analysis of redox zones is a dynamic process, where one should evaluate the concentration (relative to background) of multiple electron acceptors to determine an appropriate redox zone for a given area and depth of the site.

The determination of redox conditions in Figures 5-2 through 5-5 was made through an assessment of the conditions at the 31 wells used for monitored natural attenuation scoring, even though all wells installed at Site 16 are shown in these figures. Therefore, not all individual wells shown in the figures are likely to agree with the localized redox condition shown for that area. The figures have been revised to depict redox zones for all Site 16 wells that have sufficient data for a redox assessment. Any wells that have an insufficient amount of data to evaluate redox conditions will be removed from revised Figures 5-2 through 5-5.

Comment 19: Page 5-19, Section 5.4.2.1 and 5.4.2.2: It is not clear what is meant by the text presented in these two sections. These sections state that the parameters measured indicate that the area has not been stressed by microbiological activity to reduce dissolved oxygen, etc. This assessment appears to neglect the fact that the current conditions in the shallow groundwater zone are likely significantly different from when releases occurred several years ago. During that time elevated concentrations of BTEX and CVOC constituents were present from review of the data. There was likely significant stress at that time with some biodegradation as indicated by residual

cis-1,2- DCE and vinyl chloride in the shallow and intermediate groundwater zones. However, in the subsequent years most of the CVOC constituents migrated away from the points of release, either vertically to depth and/or horizontally. As the major mass of contamination moves away through flushing due to infiltration, etc. over time, dissolved oxygen levels will be replenished.

Response— Comment noted. The text will be revised to include the possibility that prior contamination may have led to vastly different redox conditions. The monitored natural attenuation assessment was, however, performed with the most recent groundwater data (November-December 2002 sampling event). Therefore, natural attenuation conclusions that were drawn must be with regard to the recent timeframe.

Comment 20: P 5-19, §5.5, Contaminant Mass Distribution, last sentence, EPA requires source areas to be remediated. Focusing remedial actions on only the deeper subsurface horizons may be appropriate for an interim remedial action or a treatability study, however it would not be appropriate for a final remedial action. Please change the text to state, "...the focus of interim remedial options should..."

Response— Comment noted. The text will be revised as recommended to reflect the distribution of contaminant mass, rather than the focus on remedial options.

Comment 21: P 6-1 through 6-4, §6.1, Potential Contaminant Source Areas, please discuss the previous investigative screening data, and the screening level PID/FID hits described on the boring logs as another line of evidence to determine source areas. All available data should be used to make conclusions as to where the source areas are.

Response— Please see the Navy's response to EPA General Comment No. 3.

Comment 22: Page 6-1, Last Paragraph: It is not clear that a release occurred in the vicinity of MW16-05. CVOC constituents in this area appear to have migrated to this location from releases in the vicinity of the FFTA with subsequent migration down gradient and down dip of silt layer(s) and the bedrock surface. Additionally, there appears to have been releases in the vicinity of MW16-41S/I/D (possibly combined with MW16-40S) and MW16-42S/I/D (possibly combined with down dip migration from the FFTA and at the location of MIP16-24 in the southeastern quadrant of the "onsite" area.

Response— The Navy agrees there may be CVOC contribution(s) from other areas to the MW16-05 well cluster area. However, MW16-05I is screened to the top of a silt layer that is not continuous toward at least the south and west to provide a potential surface for CVOC migration from the FFTA or MIP16-24 areas. Therefore, it is reasonable to believe that there was a historical release (source) in the MW16-05 area based on the CVOC concentrations in MW16-05I.

Comment 23: P 6-3, §6.1, Potential Contaminant Source Areas, Old Railroad Spur Area, please provide the rationale for stating the release area is in the intermediate levels. Review of the data suggests that there is a possible release of CVOC in the vicinity of MW16-38SI. However, there does not appear to be a release in the vicinity of MW16-38I. The CVOC constituents detected at that location appear to be the result of down gradient migration of release(s) in the vicinity of MW16-37S/I/D. The soil log for MW16-38 does not show any indication of elevated response on the FID with or without filter. The soil log for MW16-37D does show intermittent detector responses with additional segments apparently not sampled (N/A).

Response— The release (source) area was referenced or named by the well designation. The intent was not to indicate an intermediate level release area. The assumption was that there was a release in the near vicinity of MW16-38I that migrated down to the silt layer on top of which this well is screened. This assumption was made, rather than migration from the MW16-37S/I (841.19 µg/L /1,101.74 µg/L total CVOC) area, because the ground-water flow direction passes through MW16-16I (200.94 µg/L total CVOC; 5 to 6 times lower) before reaching MW16-38I (1,204.35 µg/L total CVOC).

Comment 24: P 6-4, §6.1, Potential Contaminant Source Areas, Former PR-58 Nike Site, this round of sampling detected PCE, TCA, and DCA at site 16. These contaminants are constituents of DANC as has been found at site 7, although notably missing is PCA at site 16. All of these contaminants have also been found at sites 9, 3, and at the Nike FUDS. While they possibly could be impurities of TCE, EPA finds this explanation in the text highly unlikely. The text also indicates that downward gradients are not consistent across the site with the conclusion that the plume would not be moving below our data points and upwelling at site 16. However, EPA believes the general overburden groundwater flow paths do indicate groundwater flow from west to east and west to southeast across the NPL Site towards the Harbor and the Bay. It is more likely that some small portion of dissolved contamination is flowing from other areas onto the site 16 area, since we see a low levels of PCE, TCA, and DCA at the areas where both the higher levels of TCE are and at upgradient locations where TCE isn't detected. If the major source area at the Nike FUDS is not remediated soon, EPA believes that some portion of the dissolved overburden plume will be more readily noted across the NPL Site discharging into the Harbor or the Bay. Some frequency of long term groundwater sampling will be required to monitor this expected plume movement. Please add a discussion of dissolved phase groundwater horizontal flow paths.

Response— Please see the Navy's responses to EPA General Comment Nos. 4, 6B, 6C, and 6E.

Comment 25: Page 6-3, Former PR-58 Nike Site: As described in the General Comments, this location (and/or Site 03) do exhibit the potential to be low level contributors to Site 16 groundwater contamination. This Groundwater Investigation has not provided information to refute the "hypothesis." There are a number of variables, described in

the General Comments, which support this. In regard to the lack of vertical gradients, the historical data does show that there are intermittently more frequent and relatively strong downward vertical gradients from the shallow to deep and deep to rock groundwater zones. Review of the Groundwater Investigation data also shows a number of upward vertical gradients in the Site 16 area indicative of a zone of discharge. Given the heterogeneity of the site soils and rock some spatial variability could be expected.

Response— Please see the Navy's responses to EPA General Comment Nos. 4, 6B, 6C, and 6E.

Comment 26: Page 6-5, (1) Shallow ground-water zone ('S' wells): There is uncertainty regarding the direction of shallow groundwater flow in the "onsite" area in the southeastern quadrant. It appears that groundwater flows at least intermittently in a radial manner from the central portion of the "onsite" area to the southeast. See Specific Comment 14.

Response— The interpreted shallow ground-water flow in the "onsite" area in the southeastern quadrant is toward the east-northeast for both the November 2002 and March 2003 data, albeit a flatter (lesser) gradient than interpreted for the areas toward the west and north (Figures 3-19 and 3-24). The depth to ground water could not be measured in several monitoring wells during the water level measurement activity in November 2002 due to the drought conditions and the resulting low ground-water level. When the water level was below the top of the bladder pump, BTOP was noted in the field forms and on Figure 3-19. However, during the March 2003 event, the ground-water table had recovered and could be measured in most of the Site 16 monitoring wells. Figure 3-24 shows that ground water in the shallow zone moves across the onsite area to the east-northeast.

The Navy does not understand how EPA Specific Comment No. 14 relates to EPA Specific Comment 26, because it requests word changes in Chapter 1 regarding the Phase I and Phase II investigations.

Comment 27: Page 6-7, Section 6.4: It is not clear what is meant by: "a plume." It appears that there are several source areas that contribute CVOC contamination with migration occurring in one or more directions. Review of the groundwater CVOC concentrations, contours, and stratigraphy of the geology does not support one plume with one area of release. What appears to be presented is an "area of groundwater contamination." Several source areas appear to have produced a number of plumes which interact in a complex manner at Site 16. Additional work is needed in order to better define the source areas, fate and transport pathways, and interactions with each other and the surface water at the Harbor and Bay.

Response— The word 'area' was inadvertently left out and will be added just after the word 'plume'. The term 'plume area' is intended to mean the area within which elevated

concentrations of CVOC have been detected, no matter how many potential source areas contribute to it.

Comment 28: Page 6-8, Intermediate Zone, First Paragraph, last sentence: It is not clear that MW16-37 and MW16-38 represent two separate releases. There were no FID responses in the soil at the location of MW16-38 while there were at MW16-37. Based upon the groundwater contours presented it appears that detected chlorinated compounds at this location derive from the vicinity of MW16-37.

Response— Please see the Navy's response to EPA Specific Comment No. 23.

Comment 29: Page 6-10, Section 6.5: In general, this section is deficient in presenting the Site Conceptual Model. The text provided generally just states that CVOC contamination has originated at several possible locations and has resulted in CVOC contamination of groundwater in the deep and bedrock groundwater zones. There is no site-specific discussion of pathways or routes of CVOC migration. There is no discussion of contributing plume(s), how historic migration of CVOC constituents may have been influenced by the hydrogeology including migration of DNAPL along dipping silt layer, or how migration to lower depths may have been subsequently impacted by eroded low permeability layers. There is no discussion of how migration of past releases of DNAPL along the bedrock surface may have influenced presently observed CVOC distribution. The conceptual model presented does not explain why there is elevated CVOC (TCE) contamination below Building 41.

The preceding Section 6.4 mechanically states the present state of groundwater contamination in the various groundwater zones. For instance, the only "significant" present CVOC concentrations in the shallow groundwater zone are at MW16-37S and to some extent at MW16-40S. There is no recognition of downward migration at those locations as evidenced by residual concentrations (albeit low) of degradation products along with relative increasing total CVOC concentrations with depth (i.e. shallow, intermediate, deep, etc.) with increasing concentrations at depth. Also, if CVOC distribution is to be inferred only from the presented directions of groundwater flow and the documented CVOC release areas there is no explanation for the CVOC in the vicinity of MW16-14D, MW16-15D/R, and MW16-32D other than from up gradient at the Sites 03/PR-58 areas. If there is reason to believe that the storm drain network is the primary source as appears to be inferred in the text then some data and documentation of this source and pathway should be presented.

EPA concurs that the release at MW16-37S/I/D most likely is not the cause of the CVOC detected in groundwater at MW16-14D, MW15D, and MW16-32D. However, it does not appear that the contamination is potentially the result of releases from within Building 41, either. Where does the CVOC contamination originate? EPA interprets (as described in the General Comments) that this CVOC has its origins from the "onsite" area and/or the Sites 03/PR-58 areas. Review of the data contained

in this report suggests that there is a major release area within the "onsite" area located along Davisville Road. The presence of an additional release at this location is indicated by the FID/PID results. It is also supported by the groundwater analytical results for MW16-40S, MW16-08D, MW16-41S/I/D, and MW16-42S/I/D. In addition, there appears to be another release area to the east of this release in the southeast quadrant of the "onsite" area at the location of the MIP16-24 groundwater probe location that was sampled during the Phase I Remedial Investigation. Lastly, there does not appear to be an explanation why there is an interpreted release in the vicinity of MW16-05. Rather, the CVOC constituents detected at that location appear to be the result of down gradient and down dip migration of CVOC constituents from the FFTA.

The understanding of the origins of the CVOC contaminants in groundwater (sources), likely migration pathways (both past and present), and relative contributions are critical in evaluating present and future threats to human health and the environment. Further, it is absolutely essential to the development and evaluation of potential remedial alternatives including possible "No Action" alternatives. This Groundwater Investigation while providing extensive hydrogeological and analytical data does not integrate this information into a complete and thorough picture of what is occurring at this site. In particular, the data suggesting migration onto the Site 16 area from the Sites 03/PR-58 areas still outweighs the data that would suggest this is not the case. In particular, review of the groundwater elevation data as presented in Section 6.2 and on the various groundwater contour figures shows that there is a significant gap in coverage in the groundwater elevations, resulting contours, and assessment of groundwater flow pathways from the Sites 03/PR-58 areas.

Response— A site-specific discussion of pathways or routes of CVOC migration will be added. Please see the Navy's responses to EPA General Comment Nos. 4, 6B, 6C, and 6E regarding CVOC originating from Sites 03/PR-58.

Comment 30: Page 6-12, Section 6.6: While there is evidence that biodegradation has occurred, this is not applicable to the TCE in deep groundwater, where the highest concentrations of that CVOC are currently observed. Further, evaluation and assessment of the depletion of terminal electron acceptors is masked by the occurrence of those constituents through a variety of sources including past septic system operation, landfill of waste material, and burial/disposal of organic material other than petroleum hydrocarbons. Further, while there has been some biodegradation of CVOC in the past, particularly the "onsite" area, there is no evidence that there is current or future potential to support natural attenuation of the CVOC in the deep or rock groundwater zones, albeit at even low or less than optimal conditions. EPA will provide recommendations for additional work at the next BCT meeting in September.

Response— Comment noted. As was stated in Section 5.4.4 (Natural Attenuation Summary), based on the MNA scoring, there are not significant portions of the site that indicate

strong, or even adequate, evidence of CVOC intrinsic biodegradation or chemical reduction. It was clearly stated in Section 5.4.4 that site conditions are not conducive to reductive dechlorination. This is likely the result of the absence of electron donors (or carbon substrate), except in limited site regions where documented petroleum releases have occurred (such as the FFTA).

Comment 31: P6-12, §6.7, Recommendations, please add assessment of PID/FID hits on boring logs, an investigation south east of building E319, and monitoring of all wells across the site for at least two more rounds of data after the agreed to wells are added.

Response— Please see the Navy's response to EPA General Comment No. 3 and Specific Comment No. 12. The Navy requests additional discussion with EPA regarding the monitoring of all wells across the site after there has been agreement on the addition of monitoring wells.

Comment 32: Figures 3-1 through 3-15: Specific comments pertaining to each cross section are not being made. However, it is not clear why certain additional cross sections were not constructed, or if they were constructed for analytical purposes, are not described in the text. EPA recognizes that opportunity for input was available for identifying cross sections to be included in the Groundwater Investigation Report. It should be noted that even with the request for input, though, not all recommendations for cross sections that were initially made were accepted.

The concern is that the cross sections constructed do not fully relate the nature of contaminant release areas and hydrogeologic setting, specifically the stratigraphic control of contaminant (DNAPL) migration. For instance, MW16-45 while at the center of the FFTA was not included in any cross section. In other areas, critical wells appear to have been omitted. For instance, MW16-44S/I/D should have been included on Cross Section B-B'. No cross sections were prepared from MW16-40S to MW16-22D and then to MW16-15D/R or MW16-32D; or from the area of known releases around MW16-43/44/45 to MW16-02, two known areas of high TCE in the deep groundwater and/or bedrock zones. While conceptualizing the site hydrogeology can be made with the cross sections presented the picture becomes even more clear when those additional cross sections are prepared, as was done by EPA during its review. The additional cross sections would show that contamination at MW16-29D and MW16-05D most likely originates from the FFTA, while the contamination near Building 41 most likely is at least partially from contaminants released in the southern portion of the "onsite" area around MW16-40S and MW16-41, etc.

The point of this comment is that the onus is on the Navy as the lead agency, not EPA to develop the conceptual site model in the most accurate manner possible. Therefore, the number and configurations of the cross sections should not be minimized.

Additional cross sections could be included in an appendix if deemed too cumbersome for inclusion in the main text.

Response— The cross sections were discussed and selected during the 30 April 2003 BCT meeting attended by the Navy, EPA, and RIDEM. All of those additional cross sections were prepared and incorporated in the Draft Phase II report.

Comment 33: Figure 3-17: This figure is somewhat misleading and needs to be revised. The figure implies that there is a continuous, significant, silt unit in areas not delineated. However, review of the soil logs shows otherwise. The log for MW16-25D shows a "silt" layer. However, this layer is only 4 inches thick at depth of 4 feet below the ground surface. Likewise, MW16-41D has only a 8 inches thick silt layer at 16 feet below the ground surface. MW16-21D has a 3 inches thick silt layer at 8 feet below ground surface with the next silt being at 36 feet below the ground surface. MW16-22D has two thin silt layers (several inches) at 12 and 24 feet below the ground surface with a thicker layer not occurring until 43 feet below the ground surface. MW16-23D has three relatively thin silt layers occurring at 13, 38 and 43 feet below the ground surface. Cross Sections F-F' to H-H' appear to show a thinning and disappearance of any silt in the area surrounding MW16-25D. Additionally, since a thin silt layer may provide only little retardation to downward moving contaminants, it should not be considered in the same type of unit as a thick, silt unit or an impermeable clay unit.

Response— The title of this figure will be changed to 'Interpretive Total Thickness of the Numerous and Discontinuous Silt Layers.'

Comment 34: Figures 3-19 through 3-28: Determination of groundwater flow from the Sites 03/PR-58 areas is limited by the lack of groundwater elevation data between the location of former Building 41 and the Site 03 area. Nonetheless, review of all of these figures clearly shows that the up gradient recharge area for groundwater that passes through the Site 16 area lies in the Sites 03/PR-58 areas. The Remedial Investigation needs to explain how this area is not a potential contributor of low levels to down gradient Site 16 contaminants.

Response— Please see the Navy's responses to EPA General Comment Nos. 4, 6B, 6C, and 6E.

Comment 35: Figure 3-19: This groundwater contour plot does not include a groundwater elevation for MW16-02S. This suggests minimal water in the well. The well sampling appendix (and this figure) give BTOP or below top of pump. If so, this suggests that the shallow groundwater at this location is significantly lower than the up gradient wells. Review of the well construction log elevations given in the Phase I Remedial Investigation would place groundwater elevation no higher than approximately 8 feet at this time. This would also indicate a groundwater divide in the "onsite" area with groundwater flow bifurcating to the northeast and the southeast during this time of measurement. Additionally, the resolution of groundwater elevation in this quadrant of the "onsite" area is limited by the absence of any shallow groundwater wells further to the east and southeast. Based upon the data provided on this figure, it appears that shallow groundwater does not flow strictly to the northeast.

Response— Please see the Navy's response to EPA Specific Comment No. 26.

Comment 36: Figure 3-21: This figure appears to show an inflection in the 15 feet contour just south of Davisville Road and northwest of the former Building 41 location that is indicative of a controlling bedrock or buried gravel channel feature. What is the cause of this anomalous contour? Further inspection also suggests that this feature should be even more elongated toward MW-Z4-01. This contour also suggests a continuation along an axis through contours with similar inflections originating in the Site 03 area around MW -Z3-03. Review of Figures 2-3A-3C also suggests that this feature is oriented along the bedrock trough delineated through geophysical investigation and rock coring. It is noted that although MW16-55D/R was installed and did not result in detection of CVOC constituents, this well location appears to be somewhat off-axis from the axis of this trough as interpreted on the top of bedrock map. Also, review of the boring log for MW16-55 shows that the highest FID detection was noted at 46 to 48 feet below the ground surface. No well was installed at that interval. The deep well was installed where a much lower response on the FID was noted. The Navy should provide a note of explanation in the log and in the text to explain this issue.

Response— The "anomalous contour" is based on only one of the November 2002 data points and did not exist in the March data shown on Figure 3-26.

MW16-55D was screened, as are all "D" wells, to assess ground water along the top of bedrock as outlined in the QAPP. During drilling of MW16-55R2, soil samples were collected from 43 to 51 ft bgs to evaluate FID concentrations in the "high" interval encountered during drilling of MW16-55D (see Volume II, Draft Phase II Hydrogeologic Investigation). The FID readings from 46 to 48 ft bgs were 0.3 and 0.0 (FID and FID with filter). Therefore, this location is not recommended for an intermediate monitoring well.

Comment 37: Figure 3-24: There is inadequate resolution of the shallow groundwater elevation in the southeastern quadrant of the "onsite" area to determine where shallow groundwater flows. However, groundwater does not appear to flow strictly to the northeast, but toward the east and possibly the east-southeast within the southeast quadrant.

Response— Please see the Navy's response to EPA Specific Comment No. 26.

Comment 38: Figure 3-25: This figure shows groundwater contours that indicate inflections similar to those noted for the deep groundwater contours on Figure 3-21. These contours appear have their inflections oriented along the south side of Davisville Road. As with the other groundwater contours, there is a lack of data to provide adequate resolution. However, they appear to reflect a subsurface feature (perhaps the bedrock trough) indicative of a preferential pathway for groundwater from the up gradient areas. What is the cause of these inflections? They are not representative of homogeneous groundwater flow.

Response— The 12 and 13 ft contour lines have been drawn too far southwest on this figure toward well MW16-22I and will be corrected in the subject area for the next version of the Phase II investigation report.

Comment 39: Figures 3-29 to 3-32: These figures preferentially show vertical gradients for a limited number of groundwater elevation measurements. Nonetheless, they show indications of recharging groundwater in the Sites 03/PR-58 areas and discharging groundwater in the Site 16 area. Historical data enclosed in Site 03 Monitoring Event 01 report bears this out. These figures show that the vertical gradient at MW16-15D/R was neutral for the two time periods shown on these figures. However, review of the groundwater elevation data for the Groundwater Investigation (Table 3-4) during March and May of 2001, there was an upward vertical gradient from the rock to the deep groundwater zone at this well. For the November 2002 period there was also an upward gradient from the deep rock to the rock groundwater zone at MW16-15. Also to be noted, Table 3-4 shows that there was an upward vertical gradient from the deep rock to the rock groundwater zone at MW16-02R/R2. Therefore, contrary to what is stated in the text of the report, these wells and others suggest that groundwater from an up gradient recharge area is discharging into the Site 16 area.

Response— Please see the Navy's response to EPA Specific Comment No. 6C.

Comment 40: Figure 4-2: What is the origin of the "-ethane" constituents detected in site groundwater when the stated contaminant was TCE?

Response— The origin of these constituents, which are detected in less than 6 samples at concentrations of less than 1 µg/L, is unknown. The composition of historical releases is unknown. TCE is the main CVOC that has been detected, but it has not been indicated as the only VOC detected.

Comment 41: Figure 4-3: It is not clear what is intended by the contours presented on this figure. The inferred distribution does not correlate with the groundwater flow directions provided on Figures 3-19 and 3-24. This figure also suggests a data gap in the adequacy of the groundwater well network. If there is uncertainty in the distribution of the CVOC concentrations then additional data points are necessary to refine the plot of the distribution.

Response— Data gaps are being addressed under the supplemental investigations.

Comment 42: Figure 4-5: See previous comment on figure 4-2.

Response— Please see the Navy's response to EPA Specific Comment No. 40.

Comment 43: Figure 4-6: See previous comment on figure 4-3. Also, MW16-55D had elevated FID response at the intermediate level of the soil column, yet no well was installed.

Why was this when the response at the intermediate level was significantly higher than the deep groundwater zone?

Response— Please see the Navy's response to EPA Specific Comment Nos. 41 and 36.

Comment 44: Figure 4-8B: See previous comment on figure 4-2.

Response— Please see the Navy's response to EPA Specific Comment No. 40.

Comment 45: Figure 4-8C: What is the explanation for the detection of BTEX constituents in many of the deep groundwater zone wells to the south of Davisville Road when none were detected in the shallow groundwater zone wells at this location? This contradicts what is observed within the "onsite" area where BTEX constituents are detected throughout the groundwater zones. Also what is the origin of the "-ethane" CVOC constituents? It would appear that the BTEX and ethane CVOC constituents are related to contaminant migration from the "onsite" area, the Sites 03/PR-58 areas and possibly the E-319 area.

Response— The origin of BTEX that are detected at concentrations of less than 1 µg/L is unknown. The Building E-319 area is located cross-gradient from the wells shown in Figure 4-8C and so it is not understood why it has been listed as a source for contaminants to these wells. Also, please see the Navy's response to EPA General Comment No. 6C and Specific Comment No. 40 regarding the Sites 03/PR-58 areas and '-ethanes'.

Comment 46: Figure 4-9: This figure is somewhat misleading. It appears to indicate a single northeast trending plume. However, the CVOC concentrations at MW16-43D and MW16-45D clearly indicate a contribution from that area. This would be more easily observed if a 750 ?g/L contour were inserted.

Response— Comment noted. However, the figure illustrates the area of elevated CVOC concentrations, not a single northeast trending plume, consistently using order of magnitude contour lines.

Comment 47: Figure 4-11: What is the origin of the "-ethane" compounds noted in the groundwater when only petroleum hydrocarbon compounds and TCE were reported to be disposed of at the site?

Response— There is no statement that 'only petroleum hydrocarbon compounds and TCE were reported to be disposed of at the site.' Such a statement is misleading. Please see the Navy's response to EPA Specific Comment No. 40.

Comment 48: Figure 4-12: EPA believes there is insufficient data to draw the contours presented on this figure.

Response— The interpretive contours have been drawn only where data is present and aid in illustrating where data is available and where data gaps are present. This figure was used to aid in preparation of the recommendations for additional investigation.

Comment 49: Table 2-3: What is the explanation for the elevated pH values in groundwater for a number of wells? This is not explained in the text. The values given are not typical for ambient, background levels of overburden or bedrock groundwater for this region. These elevated pH values when plotted lie in a general trend line back to the Sites 03/PR-58 areas. Those two locations were known to have operational practices that would potentially introduce significant alkaline material to the groundwater, the PR-58 Nike Acid Neutralization Pit or the CED Area Battery Acid Disposal Area.

Response— Please see the Navy's response to EPA General Comment No. 6E.

Comment 50: Table 3-5: Why are the values of hydraulic conductivity for a number of monitoring wells different in this table than those provided in the Phase I Remedial Investigation? For instance, Table 3-4 of the Phase I Remedial Investigation report for MW16-15D gives a value of 203.7 feet/day for rising head and 47.53 feet/day for falling head while this table gives a value of 12.77 feet/day. This table gives a value of 1.84 feet/day while the Phase I report give values of 118.8 and 7.505 feet/day for rising and falling head, respectively. MW16-25D previously had a value of 456.9 feet/day while it is now given as 4.48 feet/day. There are other inconsistencies in the hydraulic conductivity values for several monitoring wells that should also be explained.

Response— Slug test data from both the Phase I and II investigations were re-calculated during the writing of the Phase II Investigation Report using the same software and method (AquaSolv) for consistency, resulting in the values shown in Table 3-4. This will be noted in the text of the report.

Comment 51: Figure 5-2 through 5-5: As mentioned in preceding comments there are a number of variables that limit the usefulness of attempting to develop reduction-oxidation zones based on the concentrations of the various terminal electron acceptors. However, in addition, there appear to be several inconsistencies on these figures.

Response— As stated in the Navy's response to Specific Comment No. 18, Figures 5-2 through 5-5 are presented to provide a qualitative view of where redox conditions may be conducive to promote reductive dechlorination, given that the right combination of electron donors and electron acceptors are present. These findings were shown to subjectively illustrate the potential for promotion of reductive dechlorination, not to definitively indicate the process. As previously stated, the AFCEE and EPA scoring process, which utilizes 29 weighting criteria, was developed to normalize for site specific electron acceptor anomalies.

The determination of redox conditions in Figures 5-2 through 5-5 was made through an assessment of the conditions at the 31 wells used for monitored natural attenuation scoring, even though all wells installed at Site 16 are shown in these figures. Therefore, not all individual wells shown in the figures are likely to agree with the localized redox condition shown for that area. The figures have been revised to depict redox zones for all Site 16 wells that have sufficient data for a redox assessment. Any wells that have an insufficient amount of data to evaluate redox conditions will be removed from revised Figures 5-2 through 5-5.

Comment 52: Figure 5-2: This figure shows methanogenesis occurring around MW16-45S. Review of Table 4-9 indicates that the area should include MW16-43S, MW16-44S, and MW16-46S. Also, there should be an area around MW16-40S, MW16-41S, and MW16-42S. Why were these areas not included? The inclusion of all of the wells that had methane present in the shallow groundwater clearly shows that there are two areas of releases with resulting methanogenesis. The second area along the southern boundary with Davisville Road also is significant.

Response— Please see the Navy's response to EPA Specific Comment No. 51. In the process of revising these figures, the dynamic procedure of review of all available electron acceptors and biodegradation reaction products was accomplished, rather than the review of a single electron acceptor or reaction product, such as the presence of methane.

Comment 53: Figure 5-2: It is not clear what constitutes terminal electron reduction areas. Table 4-9 shows a depletion of nitrates in several wells. Assuming depletion to consist of concentrations of 1 mg/L or less, several wells in the area of the FFTA should be included as a nitrate reduction zone along with areas around MW16-02S, MW16-05S, and MW16-40S.

Response— Please see the Navy's response to EPA Specific Comment No. 51. In the process of revising these figures, the dynamic procedure of review of all available electron acceptors and biodegradation reaction products was accomplished, rather than the review of a single electron acceptor or reaction product, such as the absence of nitrate.

Comment 54: Figure 5-2: Similarly, Table 4-9 shows significant concentrations of dissolved iron and therefore, presumed iron reduction around a number of monitoring wells. These include MW16-07S, MW16-43S, MW16-44S, MW16-45S, and MW16-46S all located in the area of the FFTA. Why were these wells not included as an area of iron reduction? Also, MW16-41S, and MW16-42S have high dissolved iron concentrations and would appear to warrant inclusion as areas of iron reduction along the southern boundary of the "onsite" area.

Response— Please see the Navy's response to EPA Specific Comment No. 51. In the process of revising these figures, the dynamic procedure of review of all available electron

acceptors and biodegradation reaction products will be accomplished, rather than the review of a single electron acceptor or reaction product, such as the enrichment of ferrous iron.

Comment 55: Figure 5-3: It is difficult to follow the rationale for reduction zone delineation shown on this figure as well. Review of Table 4-9 indicates nitrate depletion at MW16-05I, MW16-13I, MW16-19I, MW16-34I, MW16-43I, MW16-45I, and MW16-46I. This figure shows only MW16-38I as having nitrate reduction. Yet, MW16-38I actually has nitrate present at a concentration of 2.04 mg/L according to Table 4-9. What is the rationale for this figure?

Response— Please see the Navy's response to EPA Specific Comment No. 53.

Comment 56: Figure 5-3: Sulfate reduction appears to be indicated around MW16-46I. Table 4-9 shows that this well had sulfates present at 7.53 mg/L. Other wells had lower concentrations of sulfates including MW16-42I, which had a value of 0.21 mg/L, yet they were not included as an area of sulfate reduction.

Response— Please see the Navy's response to EPA Specific Comment No. 51. In the process of revising these figures, the dynamic procedure of review of all available electron acceptors and biodegradation reaction products will be accomplished, rather than the review of a single electron acceptor or reaction product, such as the depletion of sulfate.

Comment 57: Figure 5-3: This figure shows iron reduction around MW16-43I, MW16-45I, and MW16-46I. However, Table 4-9 also shows elevated levels of dissolved iron for MW16-02I, MW16-05I, MW16-25I, MW16-42I, and MW16-44I. This would suggest areas of iron reduction in the intermediate groundwater in addition to the area shown.

Response— Please see the Navy's response to EPA Specific Comment No. 54.

Comment 58: Figure 5-4: This figure appears to show a large area of sulfate reduction in the center of the figure. However, review of the sulfate concentrations for groundwater in the deep zone on Table 4-9 does not support this depiction. There appears to be little, if any sulfate reduction in the deep groundwater zone.

Response— Please see the Navy's response to EPA Specific Comment No. 56.

Comment 59: Figure 5-5: There are too few data points in the rock groundwater zone to make this figure of any significant value. However, the sulfate reduction zone depicted on this figure is not supported by the data provided in Table 4-9. Table 4-9 shows significant concentrations of sulfate in groundwater for these well locations.

Response— Comment noted. The figure will be revised to show redox zonation only in localized regions surrounding the wells assessed.

Please see the Navy's response to EPA Specific Comment No. 56.

Comment 60: Table 5-2: Why were there no comparative calculations provided on this table for deep zone groundwater wells? There is significant CVOC contamination in the deep groundwater zone, actually the largest mass according to Table 5-3. The text of the Remedial Investigation report stated that there were additional wells where the scoring process was conducted and that the results would be provided in this table. These wells included shallow, intermediate, and deep groundwater zones.

Response— Please see the Navy's response to EPA Specific Comment No. 17.

**RESPONSES TO RIDEM COMMENTS DATED 18 AUGUST 2003 ON THE
SITE 16 PHASE II GROUND-WATER INVESTIGATIVE REPORT OF JUNE 2003
NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND**

Comment 1: Page 1-20 of 1-23, Section 1.2.6.4, Nature and Extent of Soil Contamination, Paragraph 1, Sentence 4: This sentence notes that CERCLA risk assessment guidance was used to evaluate human health risks. Please be advised that RIDEM Remediation Regulations (amended 1996 and 2003) must also be adhered to.

Response— Comment noted.

Comment 2: General Comment: In a number of Tables, such as in Section 4.7.5, there are PALs (Project Action Limits). Please explain how we can have a PAL when no Human Health or Ecological Risk Assessment has been done.

Response— The term PALs will be changed to Project Criteria (PC) throughout the text and tables.

Comment 3: General Comment: The only soil samples taken to date have been in the original study area (EBS 28 area) and during this investigation in Building 41. In order to fully characterize this site additional soil samples will need to be taken across the site to assess whether residential conditions are met within the marina area and commercial/industrial conditions are met in the remainder of the site. The soil standards delineated are based on the Base Reuse Plan approved in 1994. This information will be necessary in order for the Navy to demonstrate that this property can be transferred as part of the BRAC initiative. The Navy should prepare a work plan for this study.

Response— A draft Supplemental Phase II Investigation QAPP addendum is planned to be submitted in late January 2004 for review and comment.

Comment 4: General Comment: A human health and ecological risk assessment will need to be prepared in order to evaluate whether a remedial action will be required or not.

Response— Comment noted. The Navy agrees that the supplemental human health and ecological risk assessments will need to be prepared in order to evaluate whether a remedial action is necessary based on additional Phase II RI information.

Comment 5: General Comment: In accordance with Section 8.08 of the RIDEM Remediation Regulations points of compliance will need to be established for both soils and groundwater. As of this writing these points have not yet been established, i.e. further characterization is needed for both media.

Response— The Navy plans additional investigation under the Supplemental Phase II Investigation. A draft Supplemental Phase II Investigation QAPP addendum is planned to be submitted in late January 2004 for review and comment.